

Appln. No.: 09/978,158
Amendment Dated March 28, 2005
Reply to Office Action of December 27, 2004

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Remarks/Arguments:**Restriction Requirement**

Applicants affirm the provisional election of Invention I, claims 1-15, made on November 15, 2004. This election is made without traverse. Accordingly claims 16-27 have been withdrawn from consideration in the present application.

Objections to the Drawing

Applicants note that the box objecting to the Drawing filed on October 16, 2001 has been checked on the Office Action Summary. As no detail of this objection is provided in the body of the Official Action, Applicants assume that the box has been checked in error. Confirmation is respectfully requested.

Objections to the Claims

Claims 1 has been objected to for certain informalities described in paragraph 7 of the Official Action. Claim 1 has been amended to correct these informalities as suggested by the Examiner. Therefore, Applicants respectfully request withdrawal of the objection to claims 1.

Rejections Under 35 USC §102(b)

Claims 1, 2, 5, 8-12, and 15 have been rejected under 35 USC §102(b) as being anticipated by VIEW INTERPOLATION FOR IMAGE SYNTHESIS, Chen et al., ACM-SIGGRAPH (1993). It is respectfully submitted that claims 1, 2, 5, 8-12, and 15, as amended, are patentable over Chen et al. for the reasons set forth below.

Chen et al. disclose a view interpolation method to portray a scene based on morphing techniques as described in the Abstract. Chen et al. begin with two images of the scene and, as described in the first paragraph of page 280, use the known camera position and orientation and range data corresponding to the images to produce morph maps between the images. There are two morph maps produced, representing forward warping, and backward warping, from one image to the other (Section 2.1, paragraph 1). These morph maps include offset vectors that indicate the amount each pixel moves from one image to the other. Using these morph maps, Chen et al. then generate an interpolated image by linearly interpolating pixels of

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one of the images (the source image) along the offset vectors and forward mapping the source image to an in-between view. Chen et al. discuss the problems of overlap and holes that occur in interpolated images formed in this manner. They propose use of Z-buffering to overcome the problem of overlap. They also discuss several methods for overcoming the problem of holes, including the use of multiple interpolated images from different source images.

The present invention, as recited in amended claim 1, contains a feature which is neither disclosed, nor suggested by Chen et al., namely:

... c) determining at least two sets of warp parameters using the at least two depth maps corresponding to said at least two images, each set of warp parameters corresponding to warping one of the at least two images to the virtual viewpoint;... (Emphasis Added)

Independent claim 12 includes this same feature. Thus, in the present invention, as recited in claims 1, 2, 5, 8-12, and 15, creates sets of warp parameters to independently warp each image directly to the virtual viewpoint using a depth based warping algorithm. This feature of the present invention is described in the specification in paragraphs [0067]-[0069].

This feature of determining sets of warp parameters to the virtual viewpoint for each image independently is distinguished from the morph maps of Chen et al., which are based on offset vectors correlating pixels in one image two pixels in another image. Chen et al. do not disclose or suggest determining a set of warp parameters, for each image, corresponding to warping that image to the virtual viewpoint, as recited in claim 1.

Applicants also note the present invention as recited in claim 1, recites "a method to create a high quality virtual image, in real-time." In paragraph 10 of the Official Action, the Examiner states that he presumes the method of Chen et al. operates in real time. However, the last paragraph on page 279 of Chen et al. discloses that, "The morphing makes use of pre-computed correspondence maps..." This use of pre-computed correspondence maps implies that the method of Chen et al. does not operate in real time. Therefore, Applicants respectfully submit that the Examiner is incorrect in the presumption that the method of Chen et al. renders their interpolated scenes in real time.

Therefore, for the reasons set forth above, Independent claims 1 and 12, as amended, are not subject to rejection under 35 USC §102(b) as being anticipated by Chen et al. As

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claims 2, 5, and 8-11 are dependent on claim 1 and claim 15 is dependent on claim 12, these claims are not subject to this rejection as well.

Rejections Under 35 USC §103(a)

Claim 3 has been rejected under 35 USC §103(a) as being unpatentable over Chen et al. in view of 3-D RECONSTRUCTION OF URBAN SCENES FROM SEQUENCES OF IMAGES, Faugeras et al., INRIA (1995). It is respectfully submitted that claim 3, as amended, is patentable over Chen et al. in view of Faugeras et al. for the reasons set forth below.

Faugeras et al. disclose a method to reconstruct a three dimensional model of a static environment viewed by several cameras. (Introduction, paragraph 1) Faugeras et al. disclose that their method may use a feature tracker to establish correspondences between images from the different cameras. (Introduction, paragraph 6)

The present invention, as recited in amended claim 3, includes the same feature as claim 1 of determining sets of warp parameters corresponding to warping each of two images to the virtual viewpoint. Faugeras et al. neither teach, nor suggest, a method to overcome the previously described deficiencies of Chen et al. regarding this feature. Further, the present invention, as recited in amended claim 3, contains an additional feature which is neither disclosed, nor suggested by the Chen et al. or Faugeras et al., singly or in combination, namely:

... a) selecting the virtual viewpoint based on tracking at least one feature as the at least one feature moves within the scene;...

The Examiner has cited this use of a feature tracker by Faugeras et al. as corresponding to this feature of claim 3, as amended. Applicants submit that this feature, which is described in the specification in paragraph [0064], is distinguished from the feature trackers of Faugeras et al. The feature trackers of Faugeras et al. identify static features in a set of snapshot images of the scene to establish correspondences between images of different cameras, while the present invention, as recited in amended claim 3, selects the virtual viewpoint based on tracking a feature of the scene in a sequence of images as it moves through the scene. This feature of the present invention may be used, for example, to allow an observer to automatically, and unobtrusively, follow a person, vehicle, animal, etc. as they move through the scene, as described in paragraphs [0041] and [0042].

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Thus, Chen et al. and Faugeras et al. do not disclose or suggest tracking a feature of the scene to select the virtual viewpoint in the manner recited in claim 3, as amended.

Therefore, for the reasons set forth above, independent claim 3, as amended, is not subject to rejection under 35 USC §103(a) as being unpatentable over Chen et al. in view of Faugeras et al.

Claim 4 has been rejected under 35 USC §103(a) as being unpatentable over Chen et al. in view of INTRODUCTORY TECHNIQUES FOR COMPUTER VISION, Trucco et al., Chapters 7-8, Prentis-Hall (1998). Claim 7 has been rejected under 35 USC §103(a) as being unpatentable over Chen et al. in view of Rogina et al. (US Patent Application Publication 2001/0043737). Claims 6 and 14 have been rejected under 35 USC §103(a) as being unpatentable over Chen et al. in view of USING SURFACE MODEL TO CORRECT AND FIT DISPARITY DATA IN STEREO VISION, Luo et al., IEEE, (1990). Claim 13 has been rejected under 35 USC §103(a) as being unpatentable over Chen et al. in view of APPEARANCE-BASED VIRTUAL VIEW GENERATION OF TEMPORALLY-VARYING EVENTS FROM MULTI-CAMERA IMAGES IN THE 3D ROOM, Saito et al., IEEE (1999). It is respectfully submitted that claims 4, 6, 7, 13, and 14, as amended, is patentable over Chen et al., in view of Trucco et al., Rogina et al., Luo et al., and Saito et al., for the reasons set forth below.

Trucco et al., Rogina et al., Luo et al., and Saito et al. neither teach, nor suggest, singly or in combination a method to overcome the previously described deficiencies of Chen et al. regarding independent claims 1 and 12. Therefore, for the reasons set forth above with regard to independent claims 1 and 12, as amended, are not subject to rejection under 35 USC §103(a) as being unpatentable over Chen et al. in view of Trucco et al., Rogina et al., Luo et al., and Saito et al. As claims 4, 6, and 7 are dependent on claim 1 and claims 13 and 14 are dependent on claim 12, these claims are not subject to this rejection as well.

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Conclusion

In view of the amendments and arguments set forth above, Applicant respectfully submit that the above-identified application is in condition for allowance, which action is respectfully requested.

Respectfully submitted,



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March 28, 2005


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